Status of T2K and ILC in Japan

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University of Tokyo

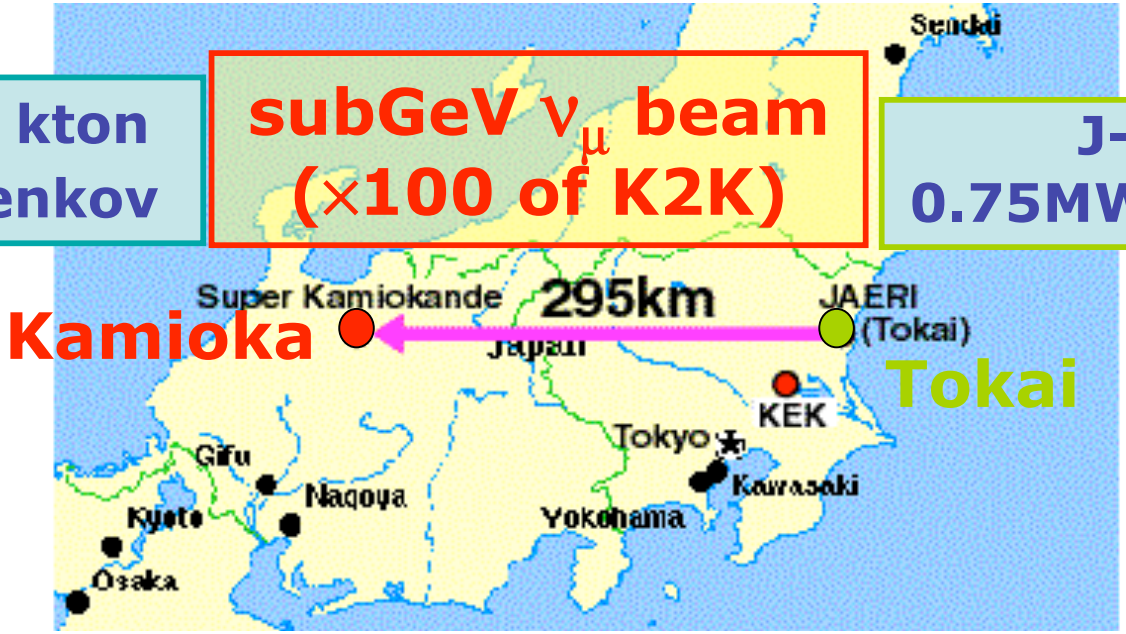
presented at Fermilab Users' Meeting on May 31, 2006

Long baseline neutrino oscillation experiment from Tokai to Kamioka (T2K)

Super-K: 50 kton
Water Cherenkov

subGeV ν_μ beam
(×100 of K2K)

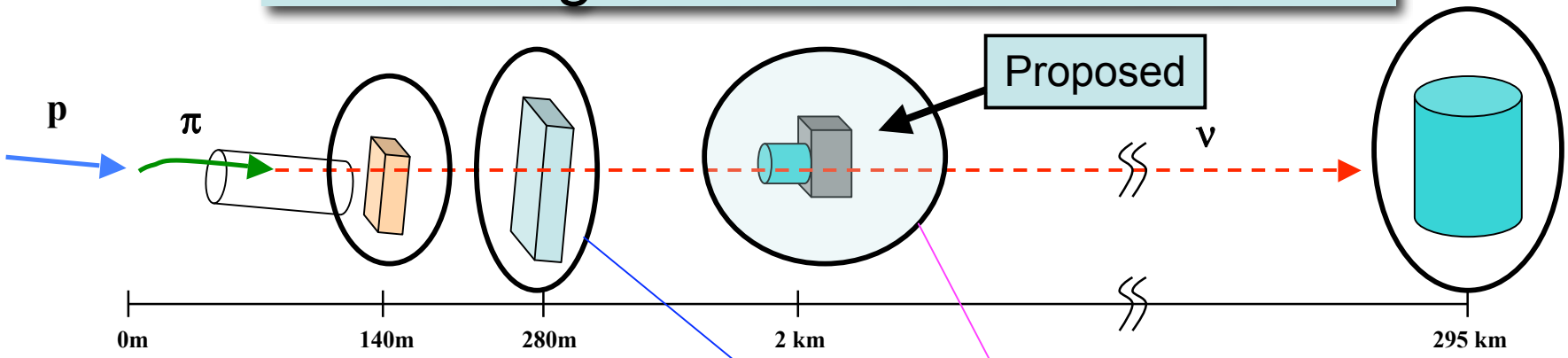
J-PARC
0.75MW 50GeV PS



Physics goals of T2K-I

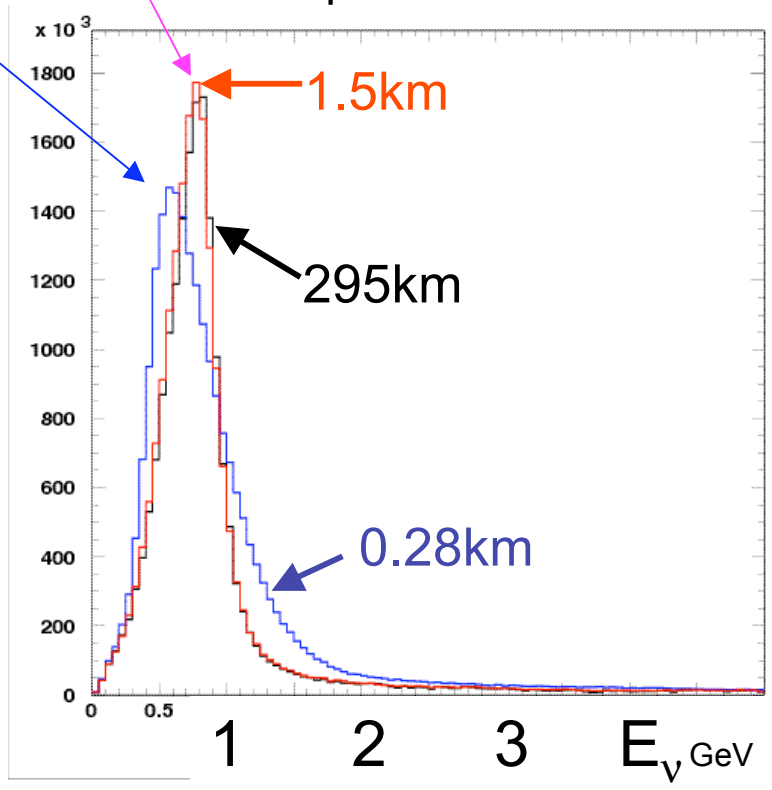
- Observation of $\nu_\mu \rightarrow \nu_e$ appearance
- Precision measurement of disappearance $\nu_\mu \rightarrow \nu_x$

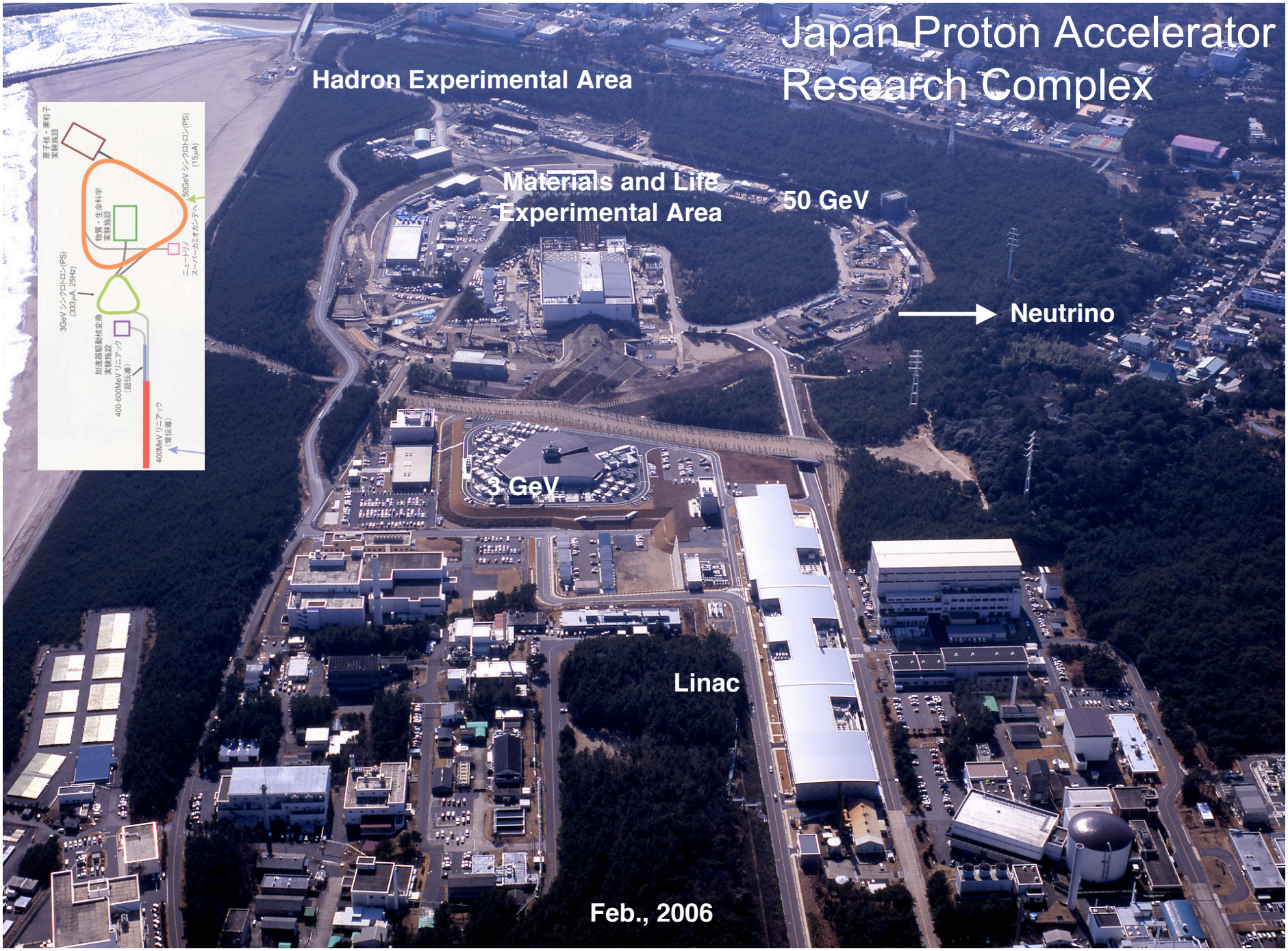
2.5 degree off-axis beam to SK



- **Muon monitors @ ~140m**
  - Fast (spill-by-spill) monitoring of beam direction/intensity ($\pi \rightarrow \mu\,\nu$)
- **First near detector @280m**
  - Flux/spectrum/νe - off-axis
  - intensity/direction - on-axis
- **Second near detector @ ~2km**
  - E_ν spectrum identical to that at SK
  - facility request in Japan after commissioning of beam line
- **Far detector @ 295km**
  - **Super-Kamiokande (50kt)**

Neutrino spectra at diff. dist




Japan Proton Accelerator Research Complex
Hadron Experimental Area
Materials and Life Experimental Area
50 GeV
Neutrino
3 GeV
Linac
Feb., 2006
原子核・素粒子実験施設
50GeV シンクロトロン(PS) (15μA)
物質・生命科学実験施設
ニュートリノスーパーカミオカンデへ
3GeV シンクロトロン(PS) (333μA, 25Hz)
加速器駆動核変換実験施設
400-600MeV リニアック (超伝導)
400MeV リニアック (常伝導)

Neutrino Beam Line for T2K Experiment

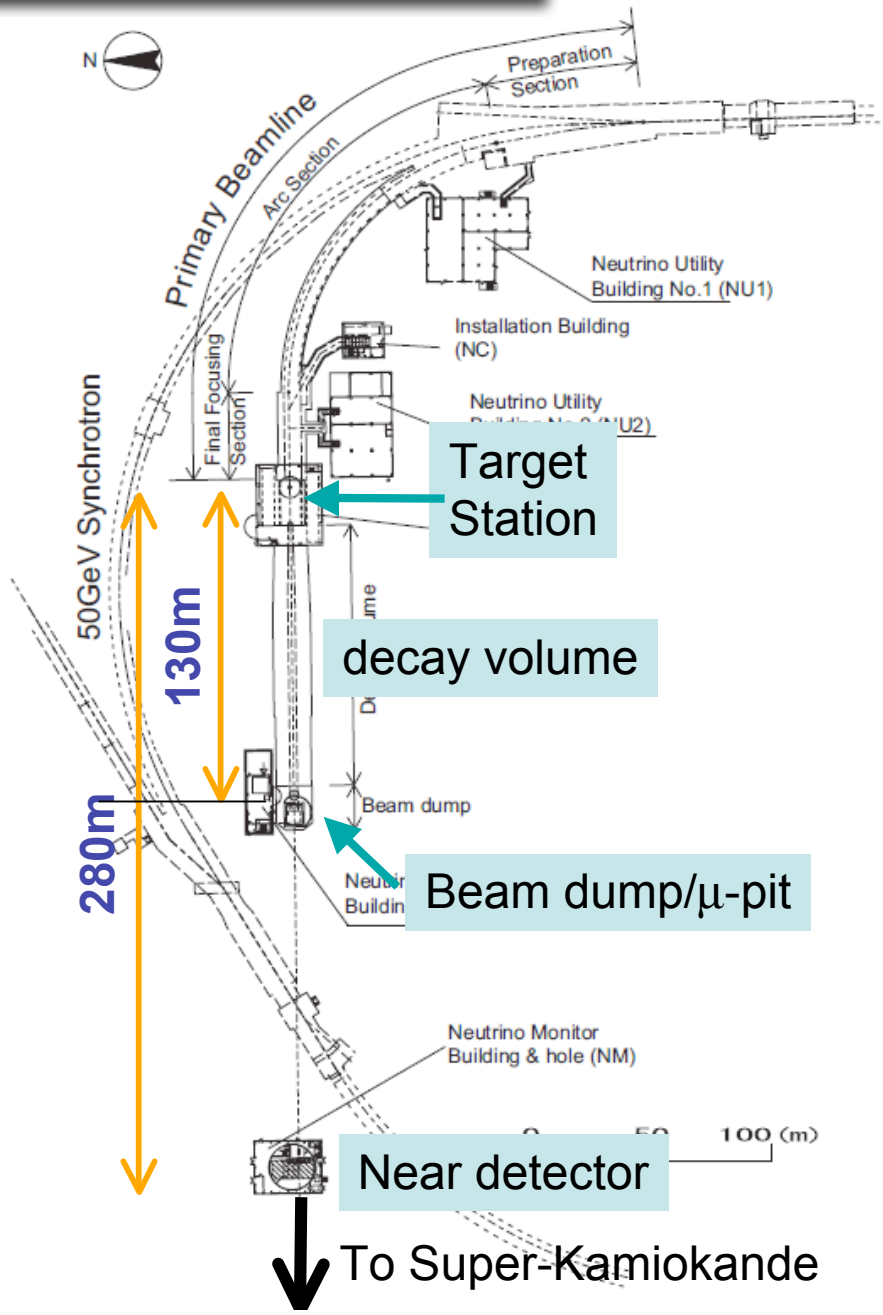
Special Features

- **Superconducting combined function magnets**
- **Off-axis beam**

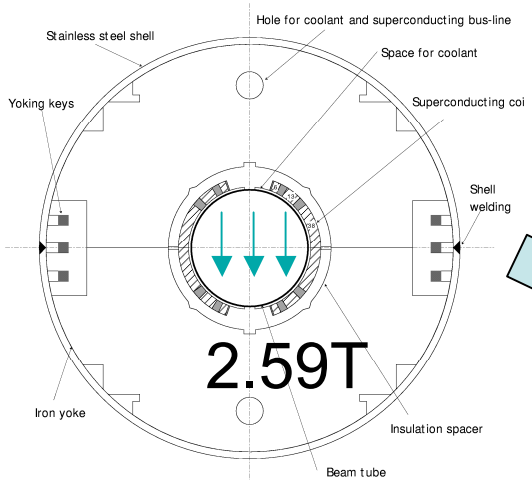
Components

- Primary proton beam line
  - Normal conducting magnets
  - Superconducting arc
  - Proton beam monitors
- Target/Horn system
- Decay pipe (130m)
  - Cover OA angle 2~3 deg.
- Beam dump
- muon monitors
- Near neutrino detector

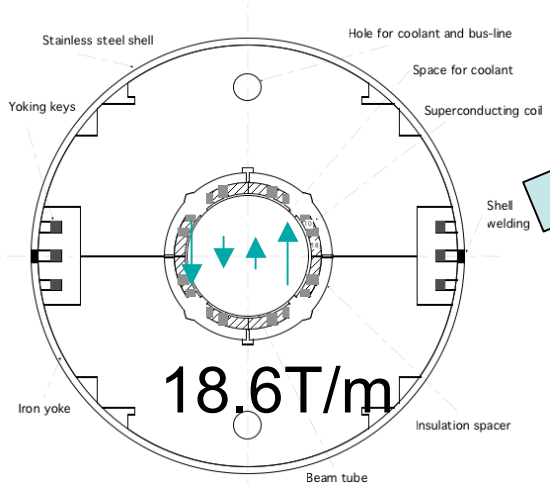
Construction: JFY2004~2008



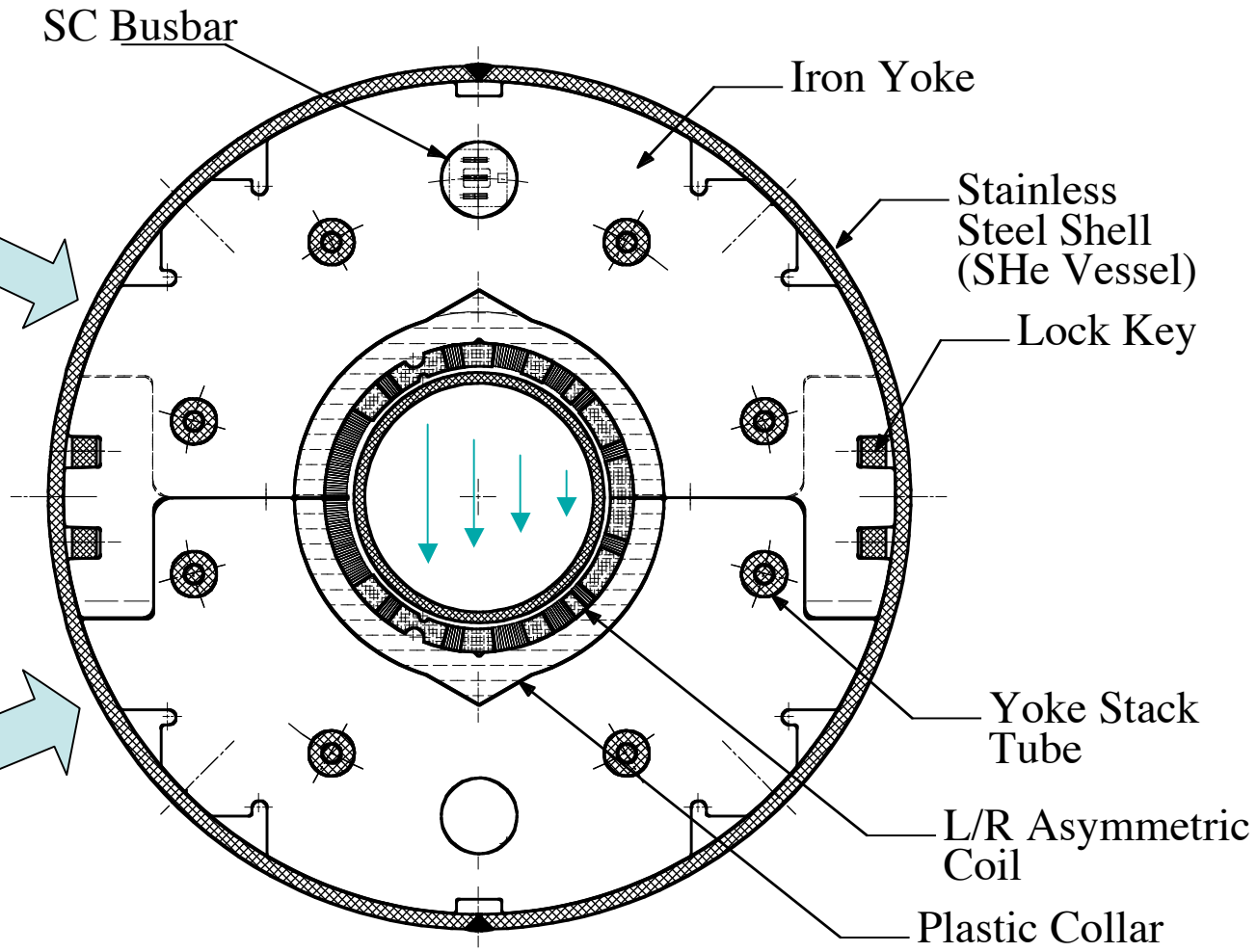
Combined Function SC Magnet



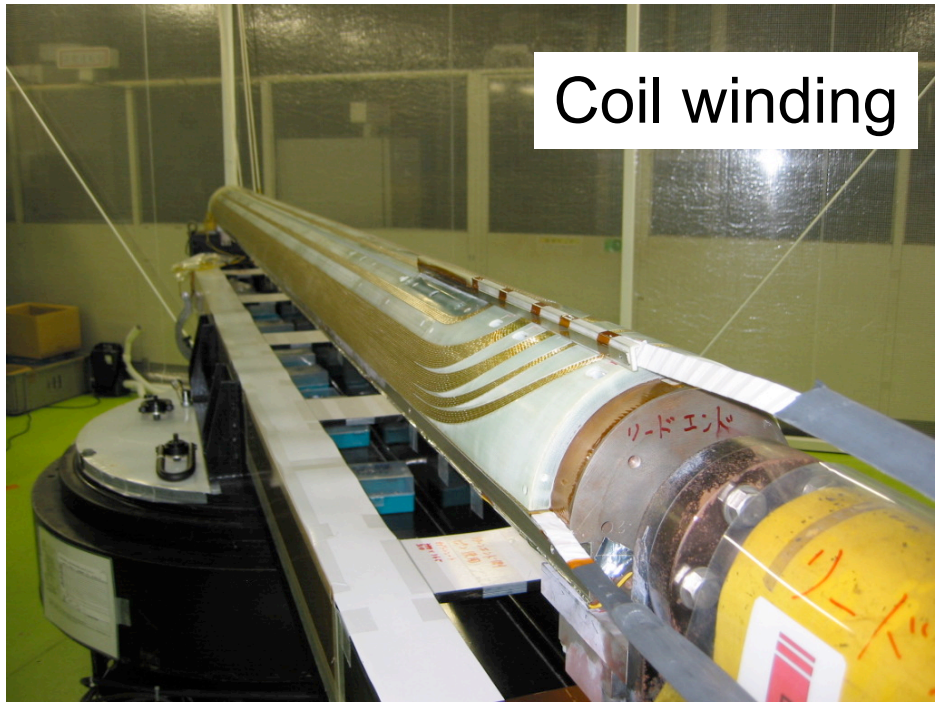
Dipole (Bending)



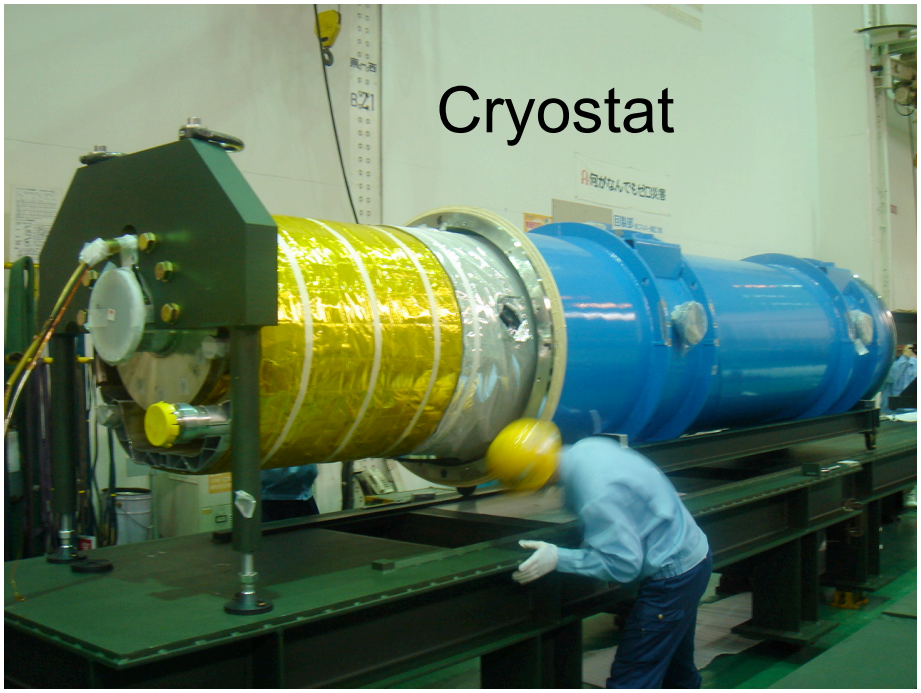
Quadrupole (Focusing)

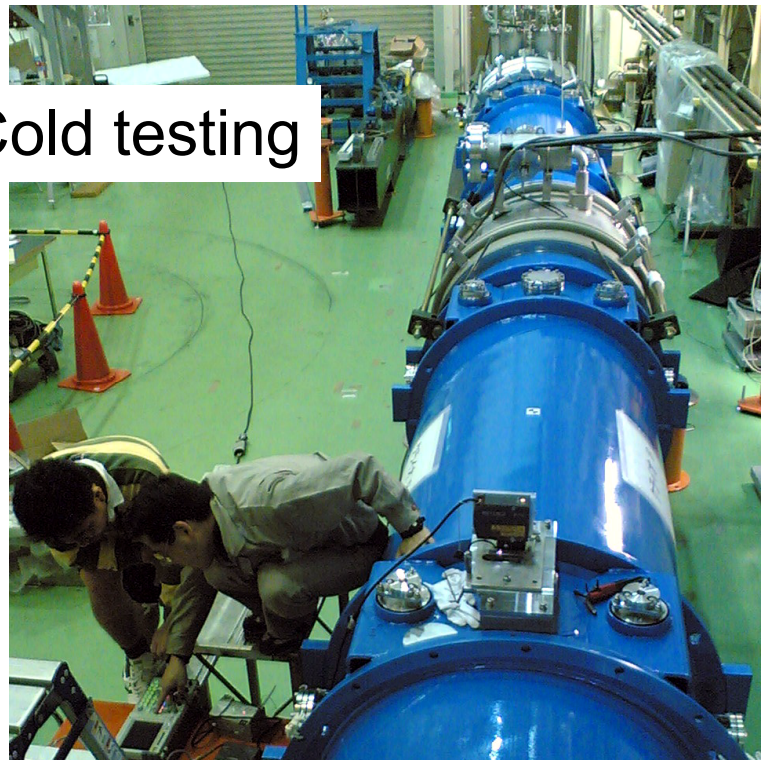


Dipole/Quadrupole Combined
Bending + Focusing


Coil winding

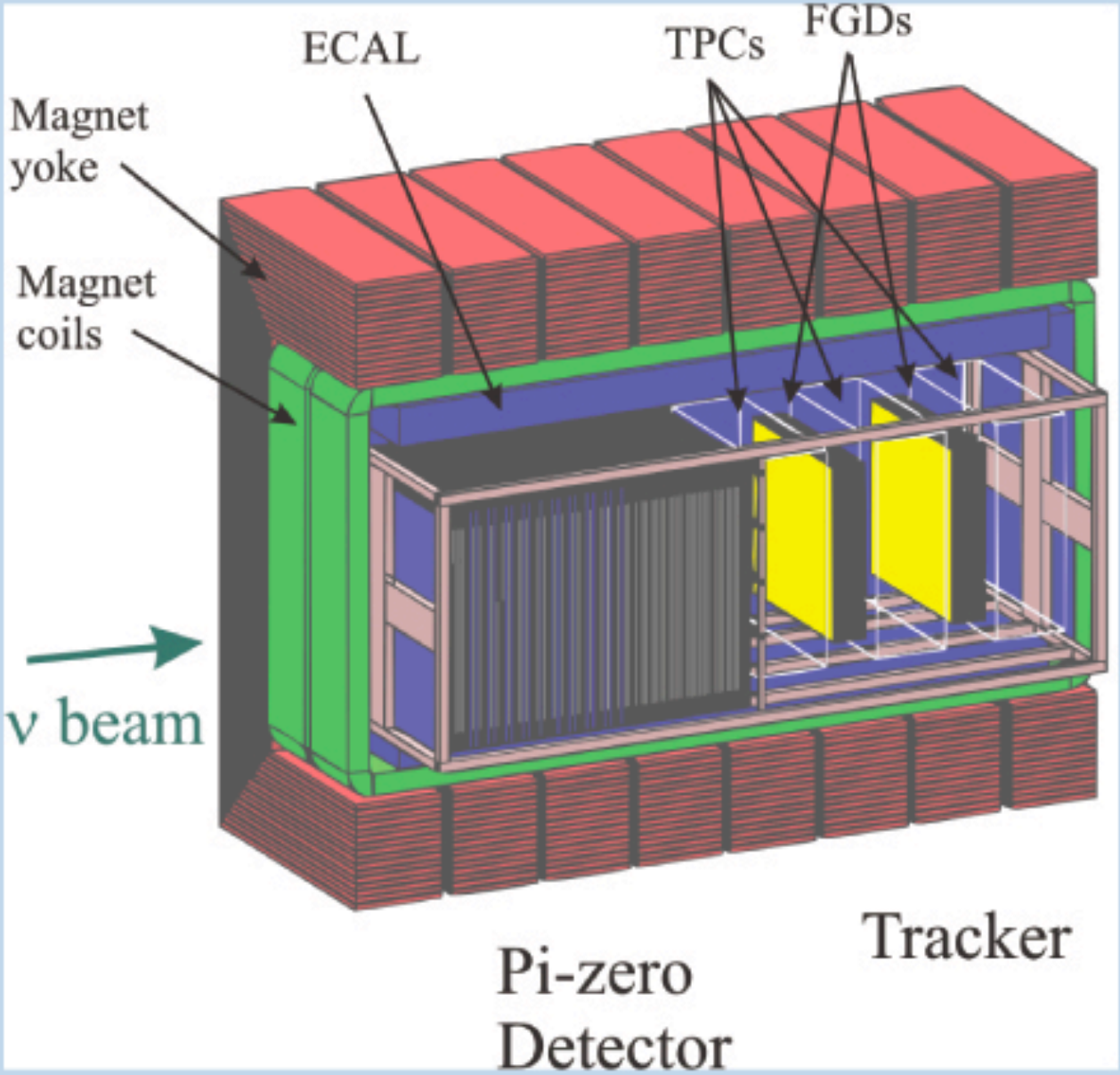

assembly


Cryostat


Cold testing

ND280 off axis detector: overview

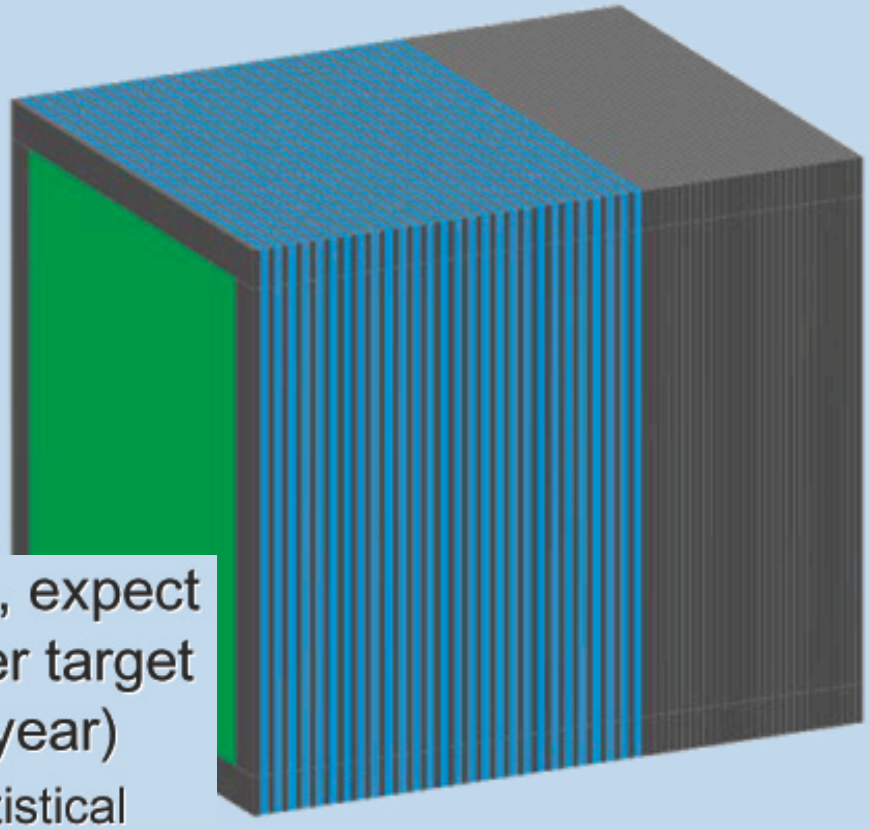
- UA1 magnet provides 0.2 T B field
- inner volume: $3.5 \times 3.6 \times 7.0\ m^3$
- front optimized for π^0 from NC
- rear optimized for CC studies
- surrounded by ECAL and muon detector



Pi-zero detector

designed to make high statistics measurements of ν interactions with electromagnetically showering particles

- scintillating bar tracking planes
- front section interleaved with passive water layers (blue)

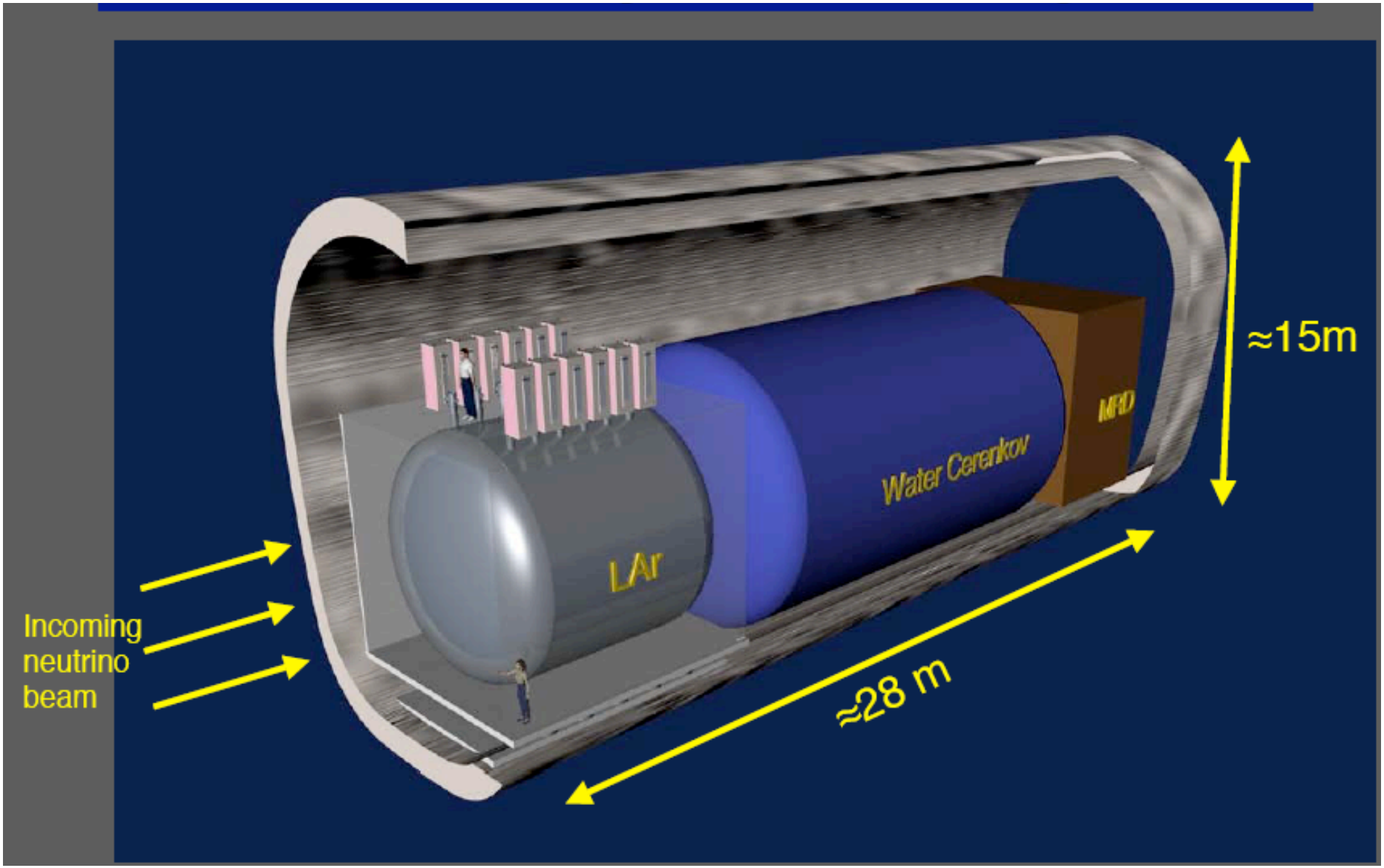


With a fiducial mass of 1.7 tons of water, expect ~17×10^3 NC single π^0 events in the water target for 10^{21} protons on target (one nominal year)

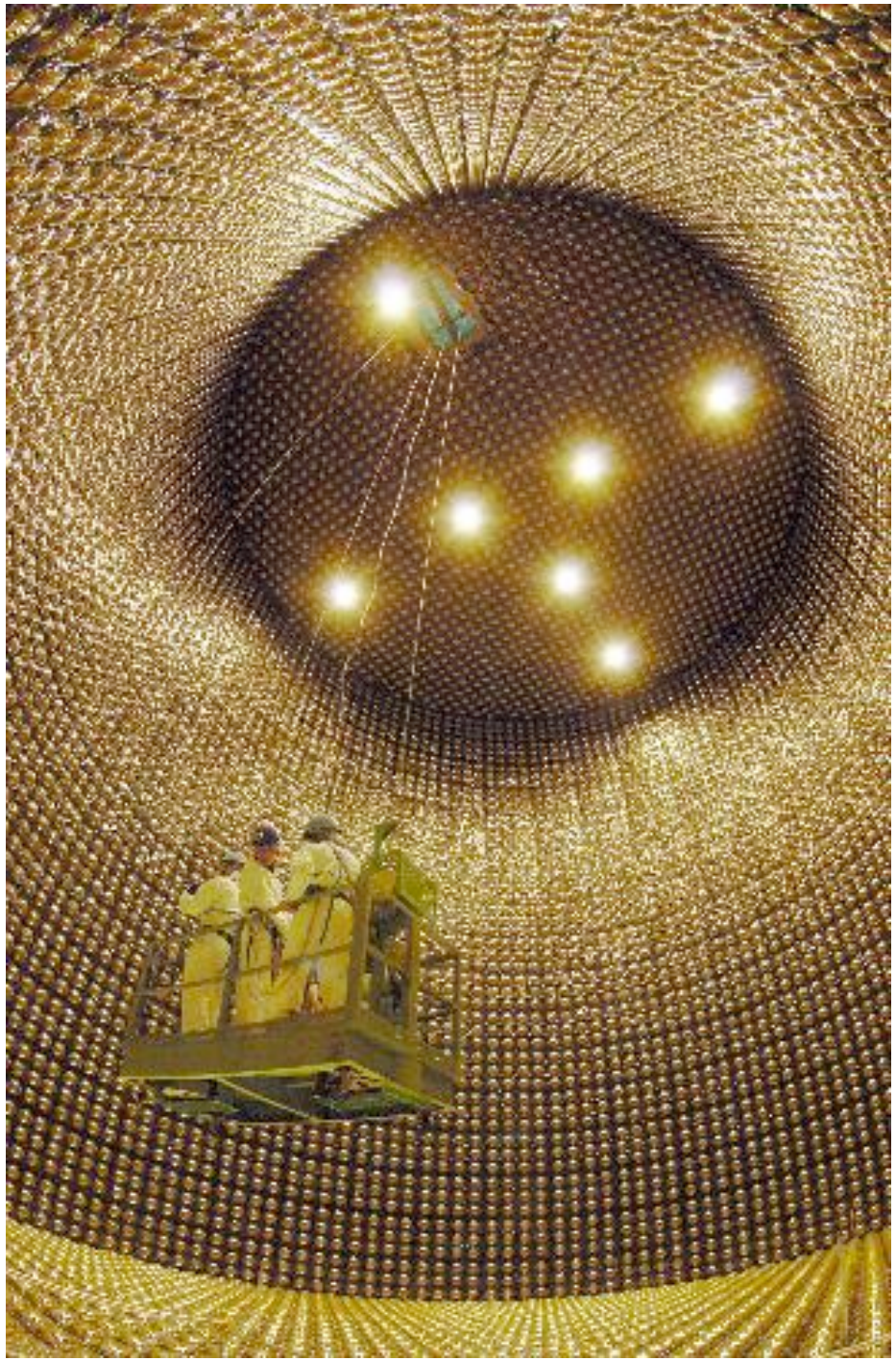
- must determine water cross sections by statistical subtraction (from total of ~60×10^3 such events)
- eff. for π^0 reconstruction, p > 200 MeV/c: 50-60%

a la Minerva

Proposed 2km off-axis detector



Goal : improve systematics from ~10% to ~5%



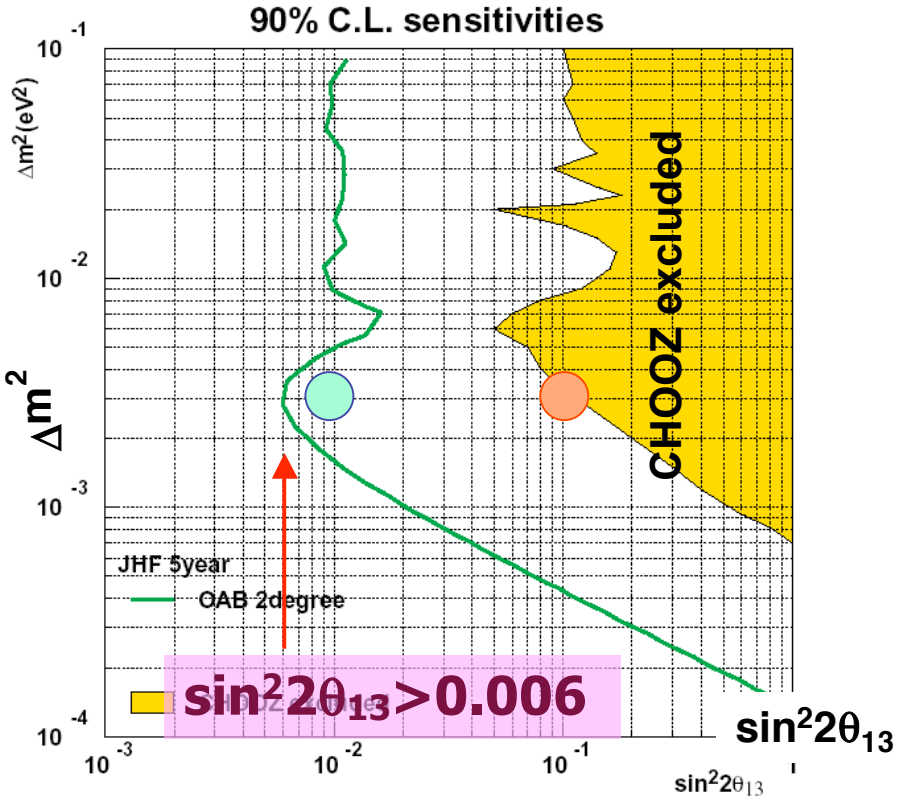
Far Detector

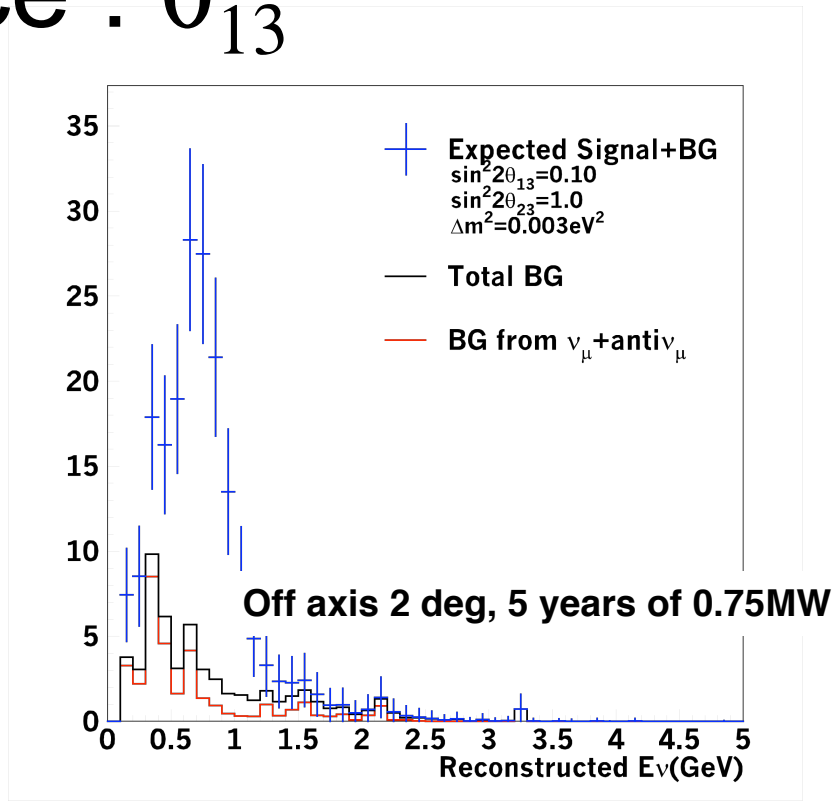
SK is back to full sensitivity to continue on

- Solar neutrinos
  (Eth down to 4MeV)
- Atomospheric neutrinos
- Super Nova neutrinos

Resume normal data taking in June.

ν_e appearance : θ_{13}



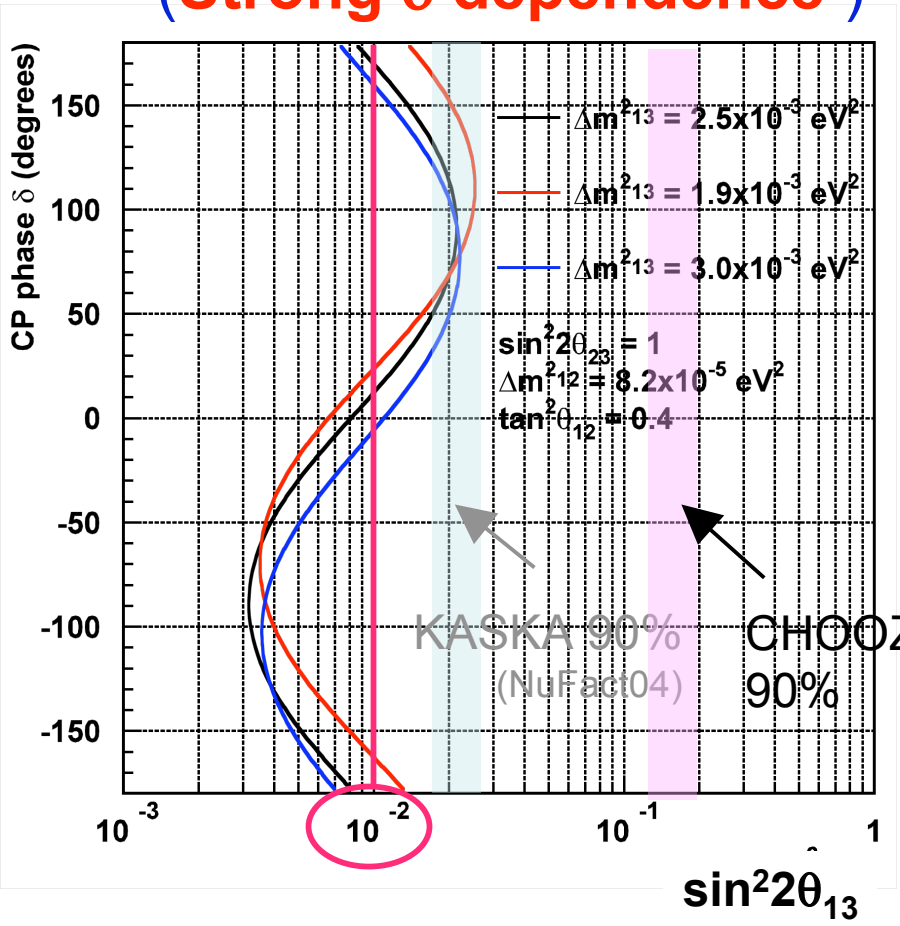


$\sin^2 2\theta_{13}$	Estimated background in Super-K					Signal (~40% eff.)	Signal + BG
	ν_μ (NC π^0)	ν_e beam	$\bar{\nu}_\mu$	$\bar{\nu}_e$	total		
0.1	12.0	10.7	1.7	0.5	24.9	114.6	139.5
0.01	12.0	10.7	1.7	0.5	24.9	11.5	36.4

T2K Physics Sensitivity without 2km detectors

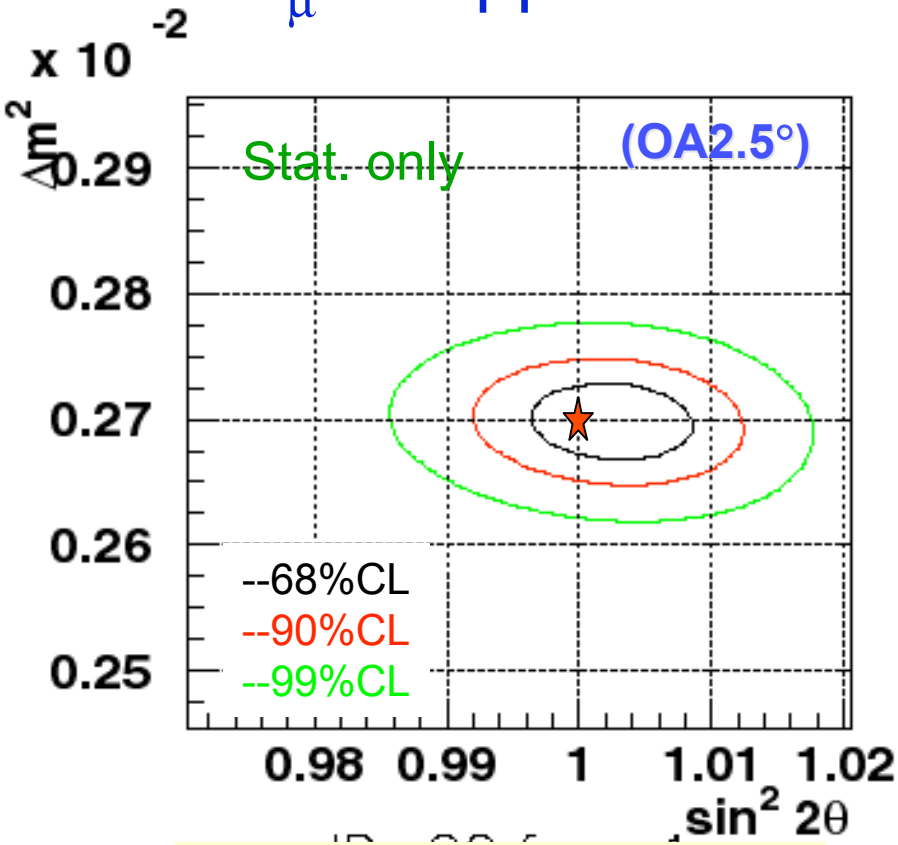
ν_e appearance

(Strong δ dependence)



a factor of >10 improvement over CHOOZ

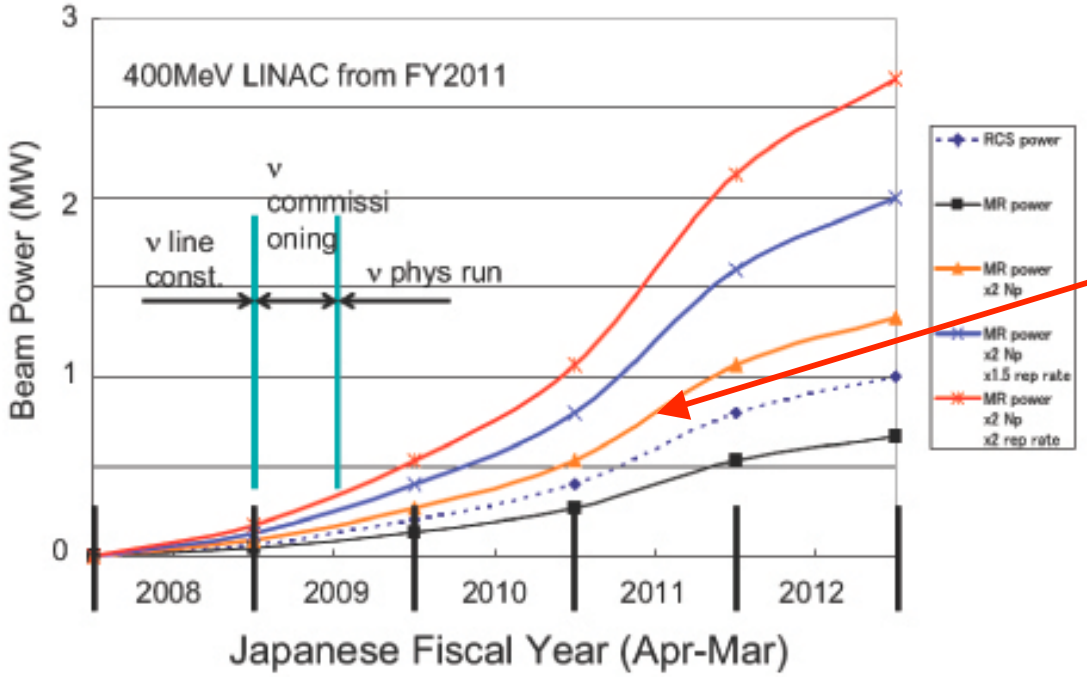
ν_μ disappearance



Goal

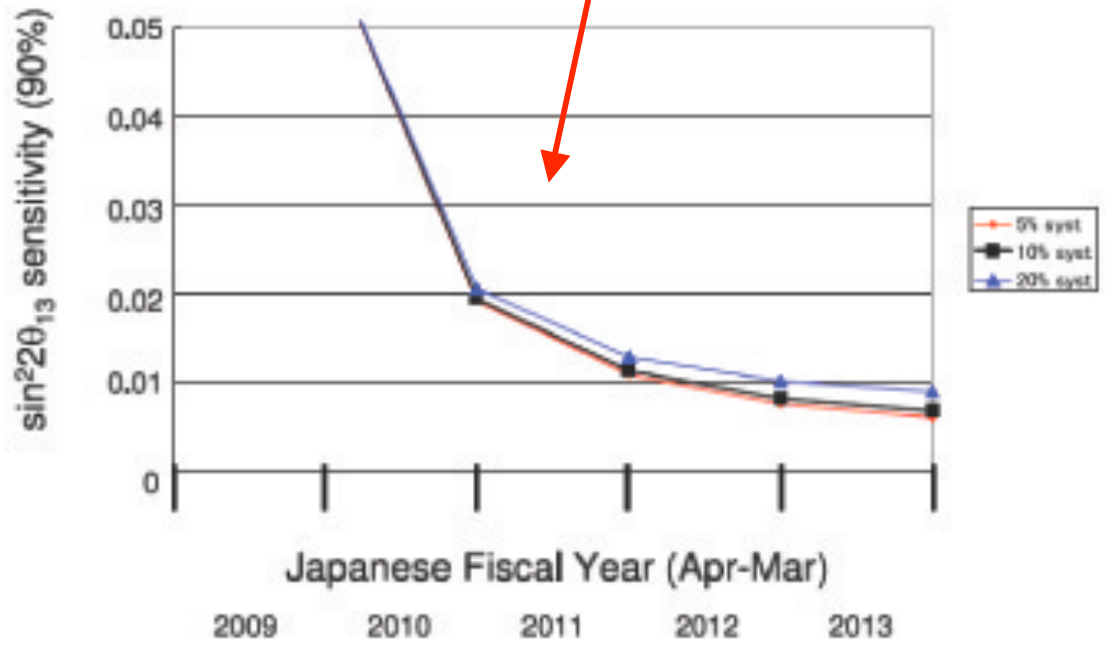
$\delta(\sin^2 2\theta_{23}) \sim 0.01$

$\delta(\Delta m_{23}^2) \sim < 1\times10^{-4}$



T2K-I

Most likely scenario

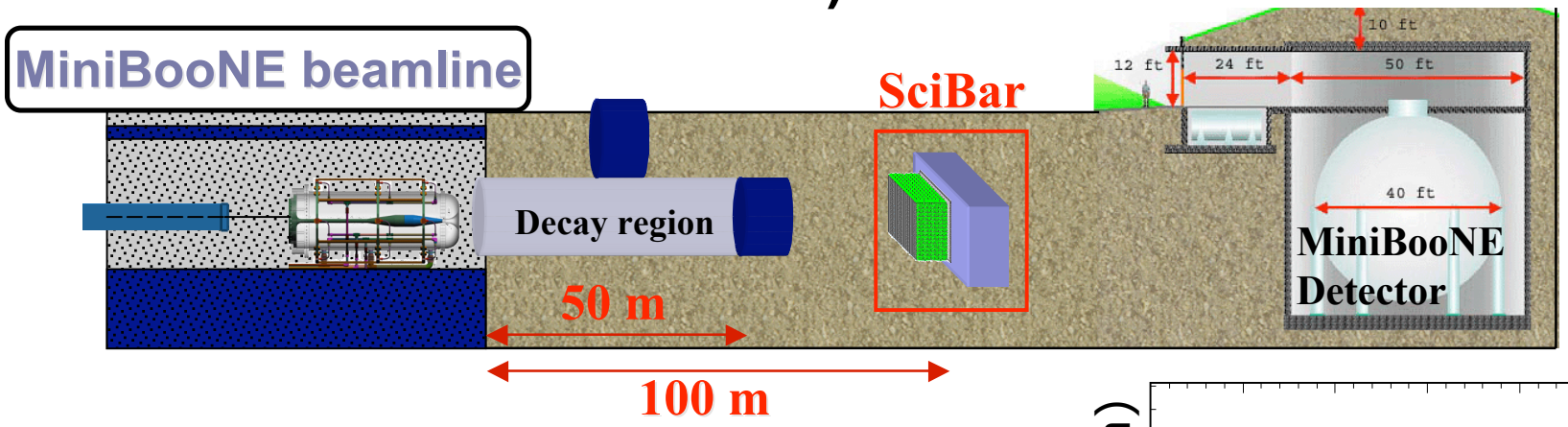


T2K Collaboration

- 11 Countries (No. of members)
  - Canada(24), France(8), Italy(11), Japan(46), Korea(9), Poland(1), Russia(8), Spain(12), Switzerland(3), UK(25), US(42)
  - 58 Institutes, 189 members.

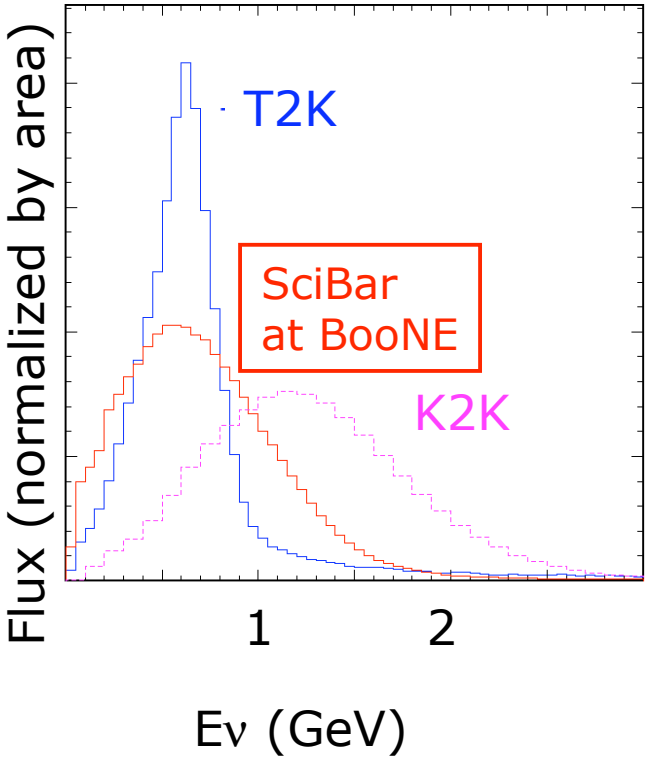
SciBooNE (FNAL E-954) [2006~ 2008]

(K2K-SciBar detector at FNAL Booster Neutrino Beam line)



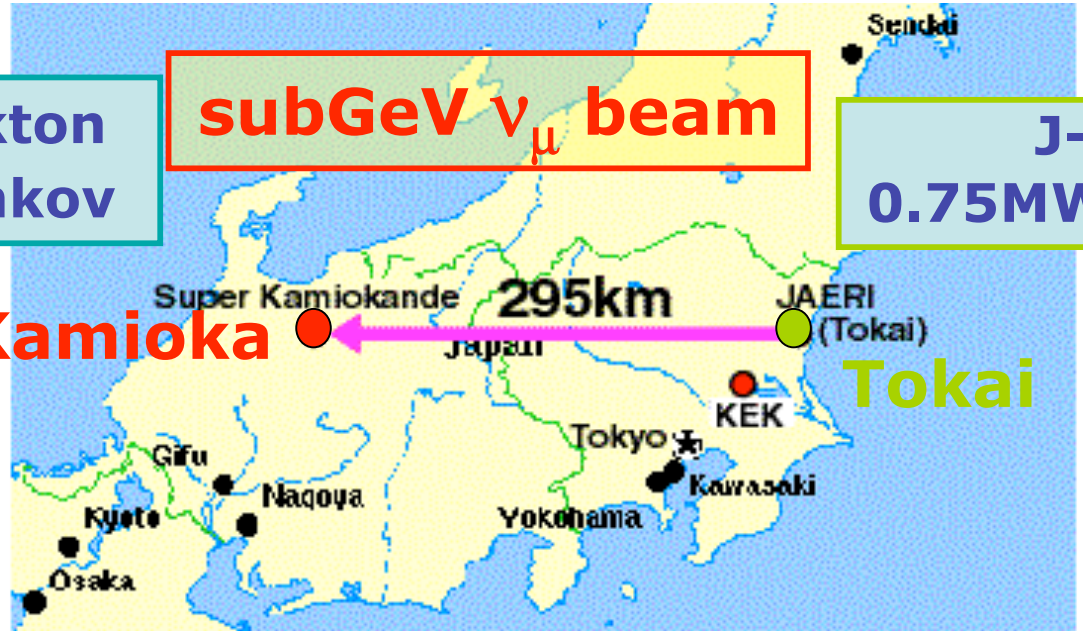
- *Neutrino Interaction study* ***for T2K***.
  - For both neutrinos and anti-neutrinos.
- MiniBooNE near detector.

Scheduled to take data this winter.



Options beyond T2K-I

T2K- II



Super-K: 50 kton Water Cherenkov

subGeV ν_μ beam

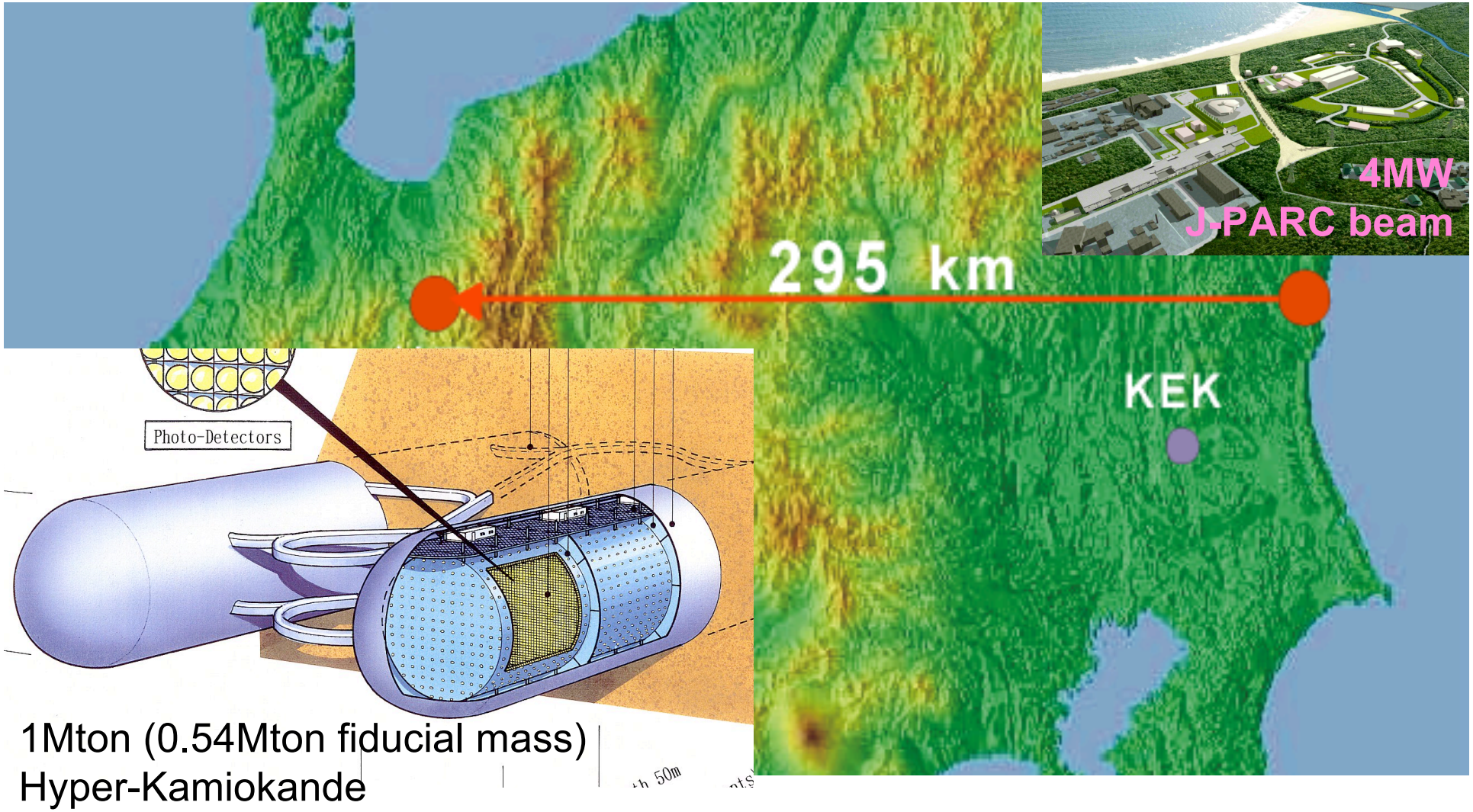
J-PARC 0.75MW 50GeV PS

Phase2: Hyper-K

Phase2: 3~4 MW

CP violation in lepton sector

T2K -II (baseline design)

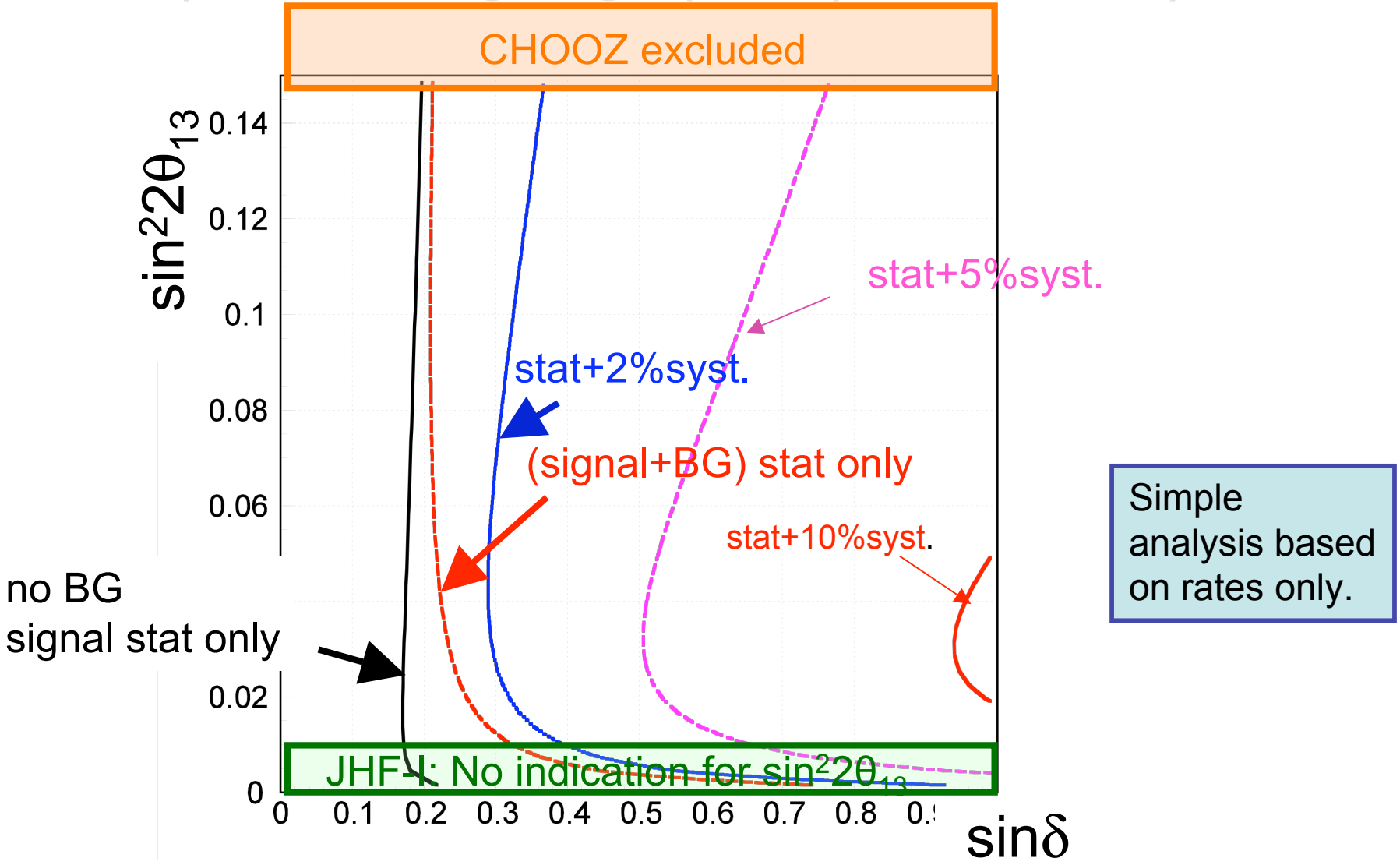


1Mton (0.54Mton fiducial mass)
Hyper-Kamiokande

2years of ν run + 6 years of anti-ν run ➔
O(0.5·10^6) events for both runs

3σ CP sensitivity

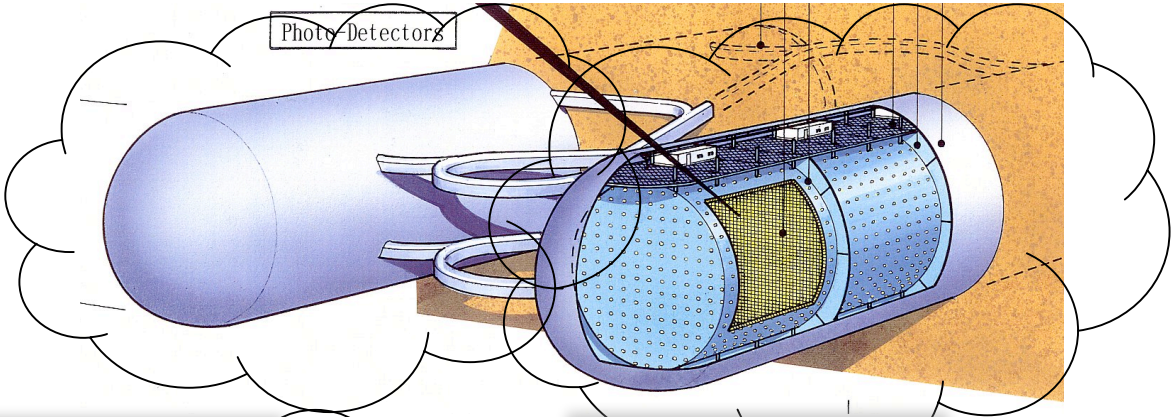
(assuming sign(Δm^2) is known)



Simple analysis based on rates only.

3σ CP sensitivity : $|\delta|>20^o$ for $\sin^2 2\theta_{13}>0.01$ with 2% syst.

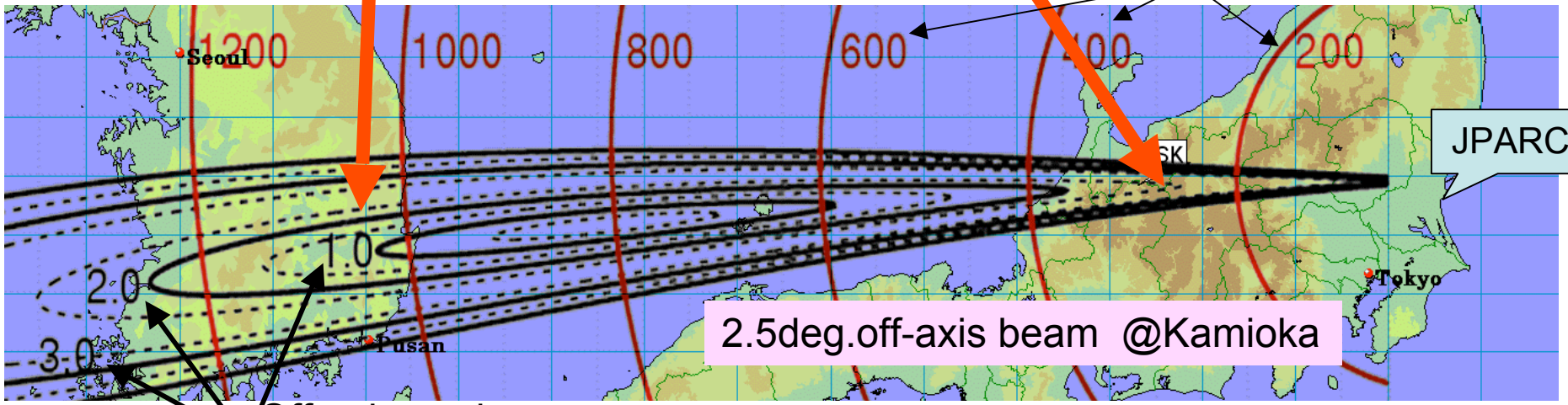
T2K & Korea



2.5 deg. off axis

2.5 deg. off axis

Distance from the target (km)



2nd oscillation max in Korea

(Matter effect still small due to low Eν)

First oscillation max at SK

Expected sensitivity

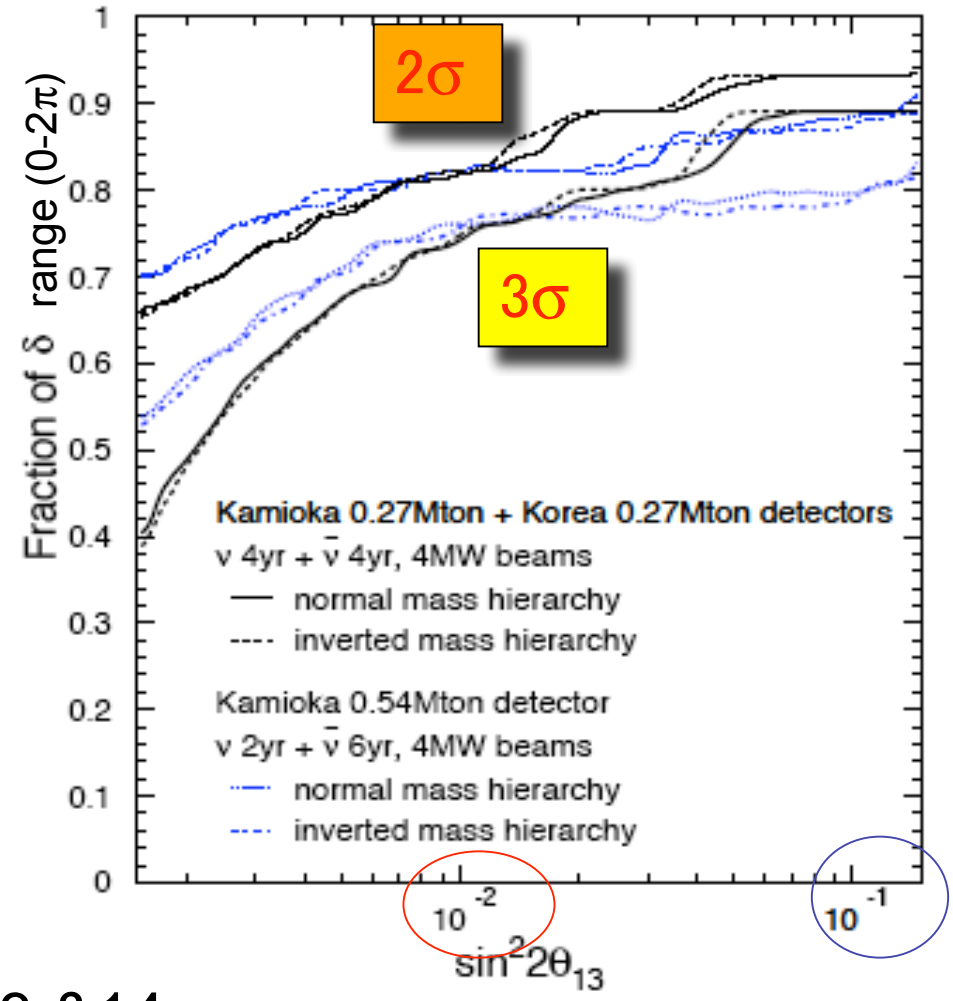
hep-ph/0504026
PR D72(2005)033003

Neutrino + anti-neutrino runs = 8 years

blue
= T2K-II
(Kamioka)
+sign of Δm^2

black
= Kamioka
+Korea

Sensitivity to CP($\sin\delta \neq 0$)



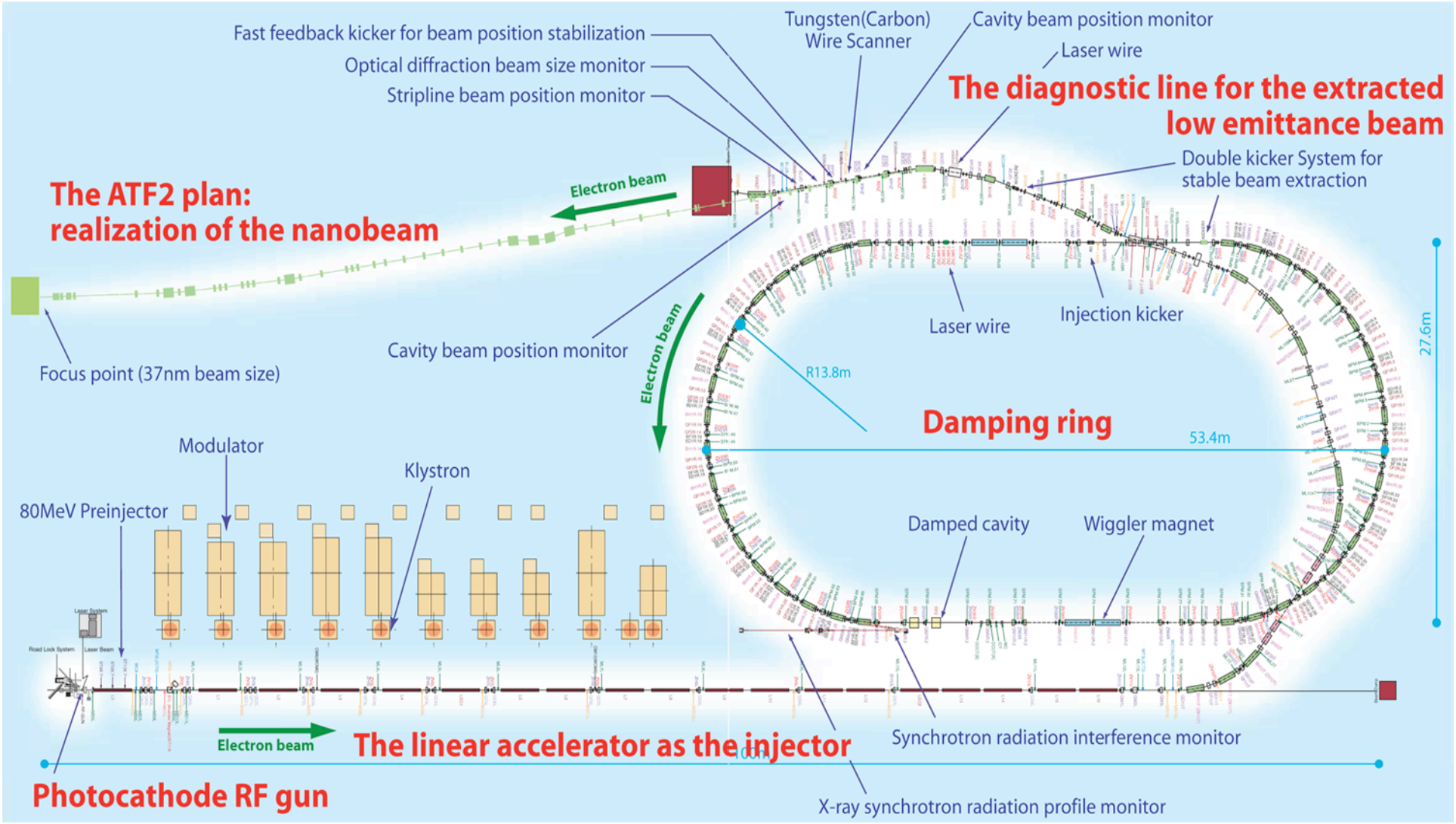
http://T2KK.snu.ac.kr

Second T2KK
workshop in July13 &14

ILC activities in Japan

Accelerator Test Facility (ATF) 2

ILC Final Focus prototype : ~35nm beam size,
beam positioning to 2nm, bunch-to-bunch feedback



Superconducting RF Test Facility (STF)

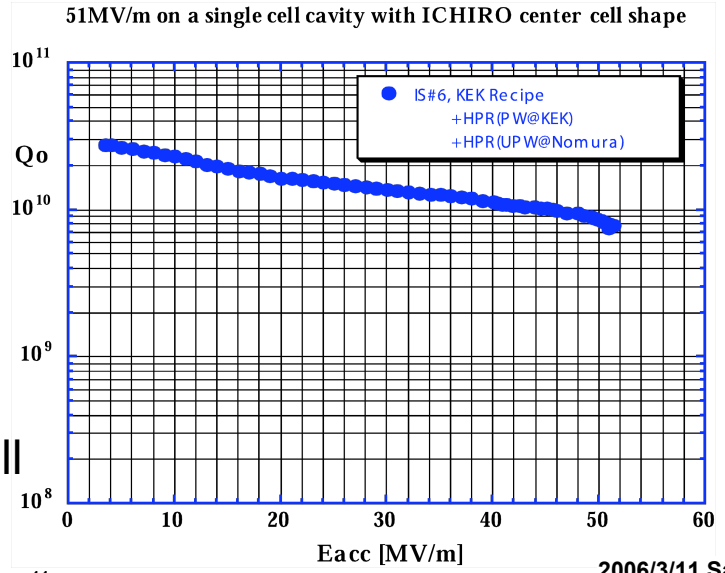
- Establish an industrial design of 35MV/m and 45MV/m cavity systems.
- Construct a linac unit by Asian/Japanese industries for accurate cost estimation.
- Build Asian regional center of superconducting technology so that Asian industries can participate in the ILC construction.
- Build up a pool of experts at both the labs and the industries towards future mass-production.

High Grad Cavity R&D

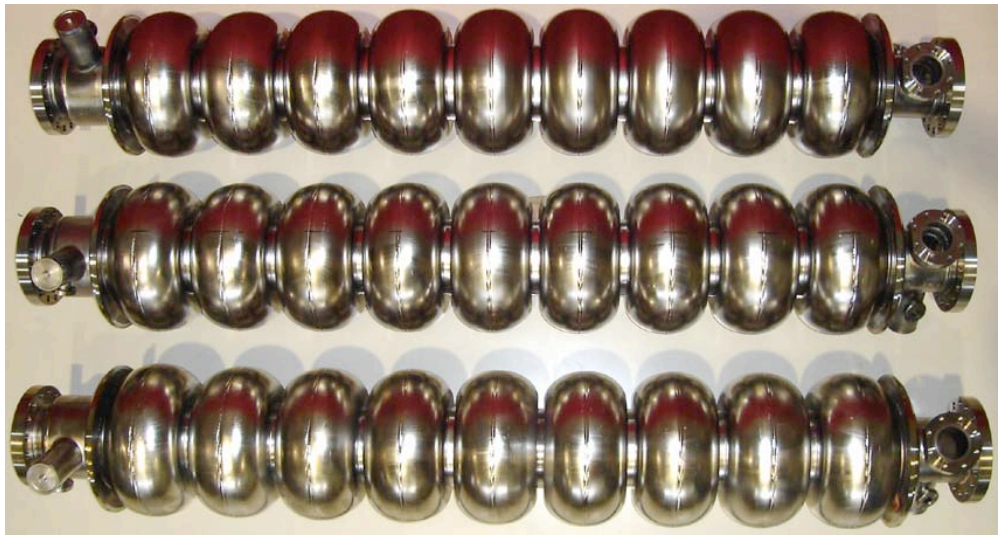
- Baseline (TESLA-type) cavity
- Low Loss-type cavity

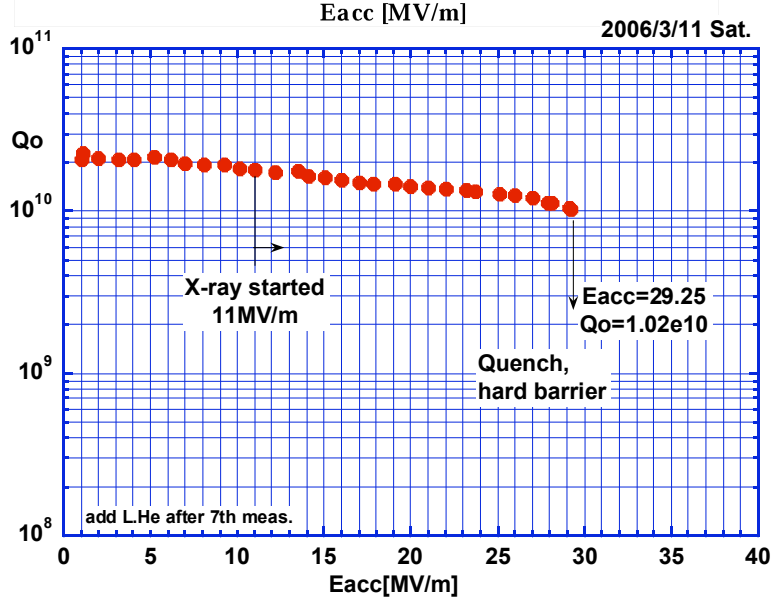
Significant contributions from Korea and China

LL Single Cell



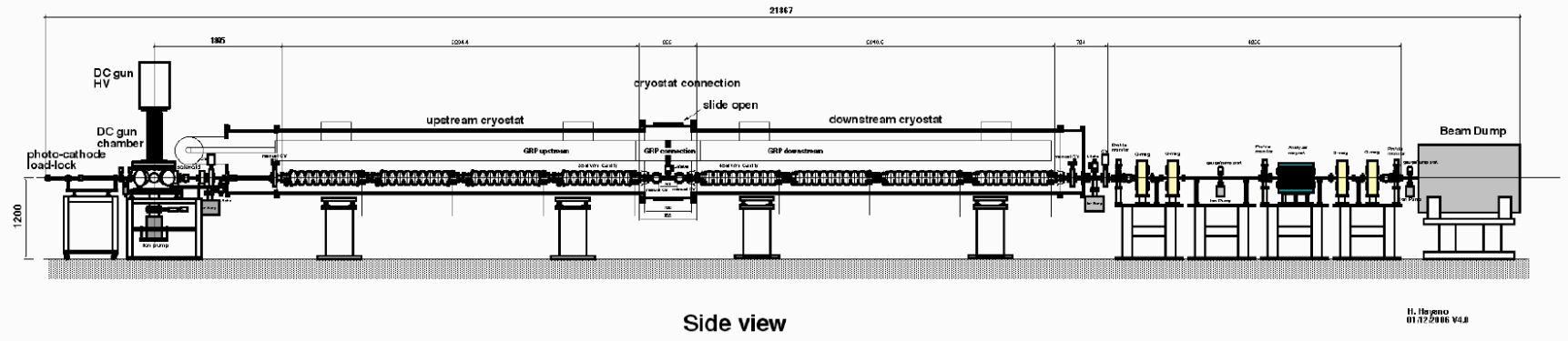
LL 9-cell





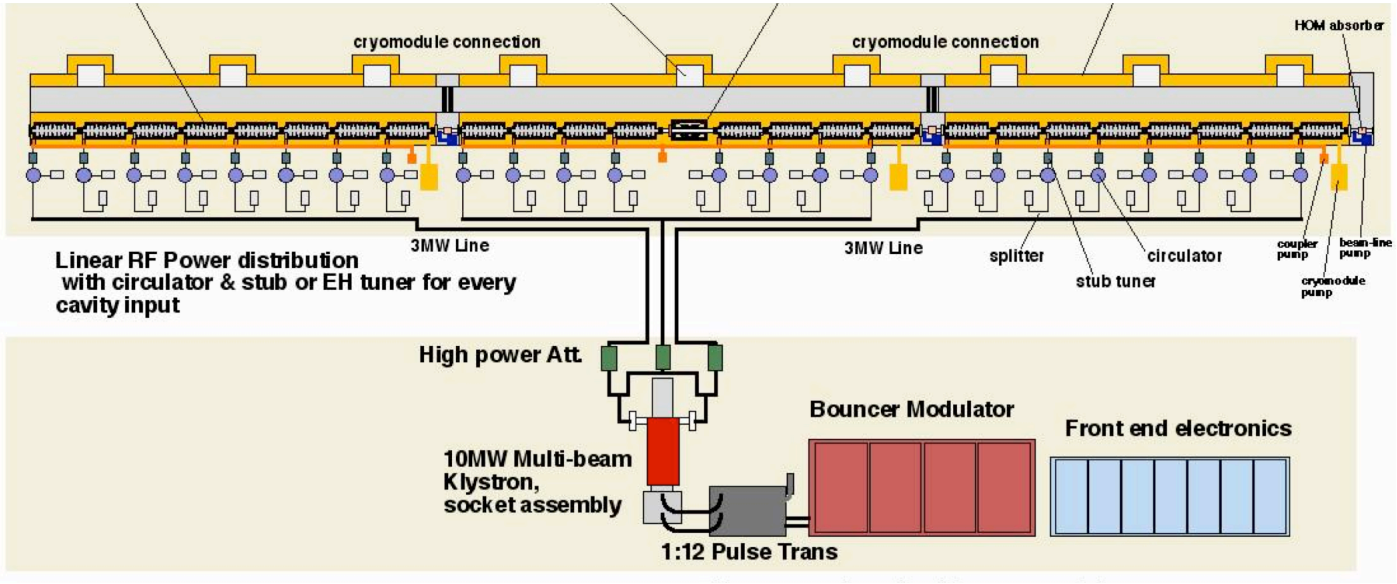
STF Phase 1 (2005-6)

- 2 cryo-modules each containing 4 cavities of the type
  - TESLA-type (nominal target 35MV/m)
  - LL (Low Loss) type (nominal target 45MV/m)
- with
  - 5MW klystron
  - second hand modulator
  - beam by DC photo-cathode gun



STF Phase 2 (2007-9)

- 1 RF Unit for ILC



- Design in 2007 (during phase 1 operation)
- Construction in 2008-9

Resources

		2005 budget	2006 budget	2006 FTE
ATF/ATF2		326	325	15.3
	ATF maintenance	154	138	8.6
	ATF study	115	76	2.3
	ATF2	57	111	4.4
STF		653	592	20.9
	Cavities	243	113	11.2
	Cryogenics	48	40	0.7
	RF	178	165	3.7
	Cryostat	90	45	1.9
	Beam/control	37	48	2.5
	Infrastructure	57	181	0.9
Travel		33	?	
Others		94	109	4.6
Total		1106	1026	40.8

Salaries not included.

in Myen

100Myen ~M$

Detector R&D

- GLD related technologies
  - CCD Vertex detectors
  - TPC
  - Silicon photosensors for CAL
- SiD
  - 5T SC solenoid

Interim Report from ad hoc committee on the Linear Collider Project

January 30, 2006
Ad hoc committee on the Linear Collider Project

The member list of this ad hoc committee is as follows:

Akihito ARIMA	Chairman of the Japan Science Foundation
Motoyuki ONO	President of Japan Society for the Promotion of Science
Yoshitaka KIMURA	Professor Emeritus, High Energy Accelerator Research Organization
Takeshi KOMURA	Governor of Development Bank of Japan
Takeshi SASAKI	Professor, Gakushuin University
Hirotaka SUGAWARA	Executive Director of The Graduate University for Advanced Studies (chairman)
Seiichi TAKAYANAGI	Technology Advisor of TOSHIBA Corporation
Yuichi TAKAYANAGI	Director of Tamarokuto Science Center
Muneyuki DATE	President of Foundation Advanced Technology Institute

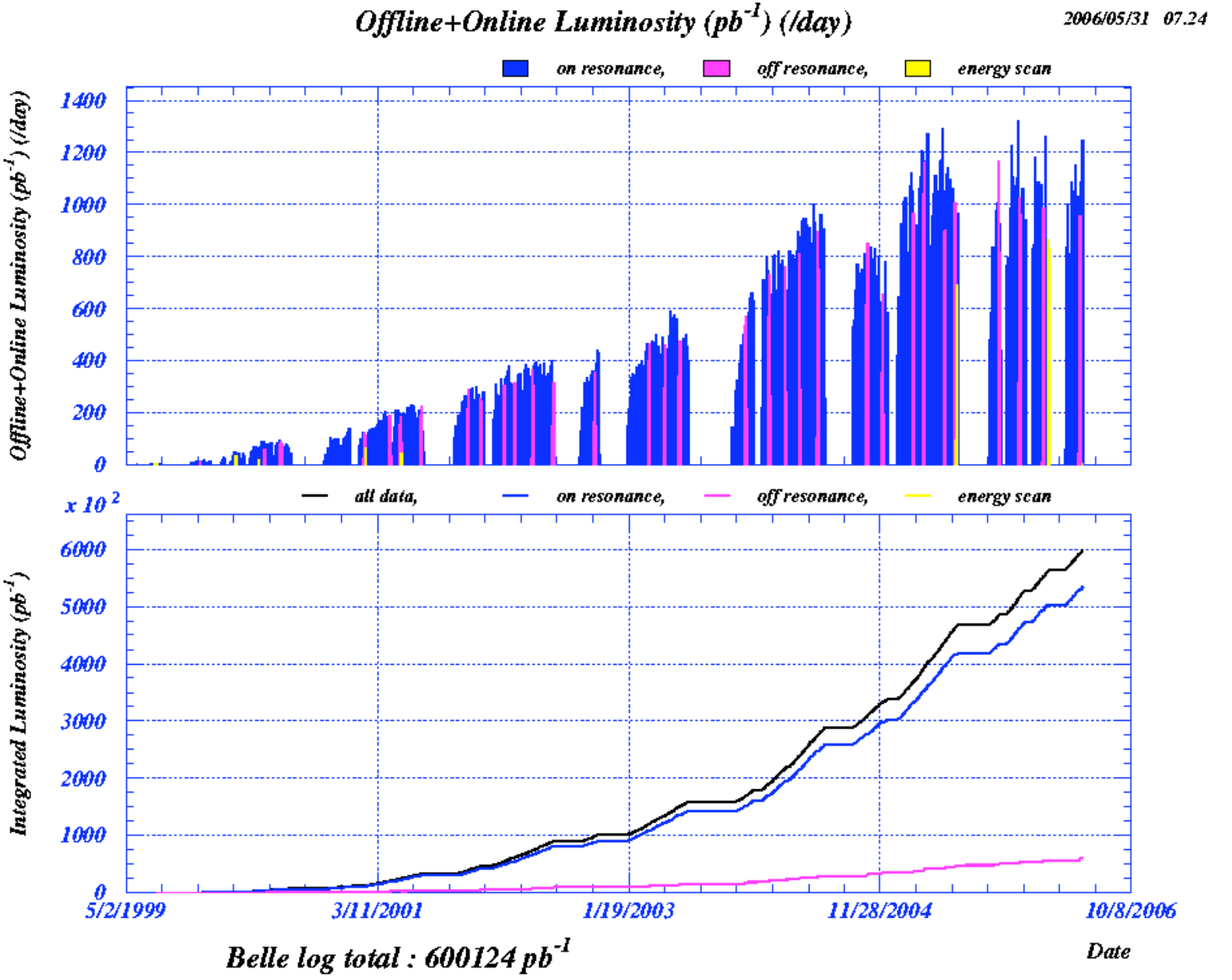
excerpts from recommendations

3. While the GDE has issued the Baseline Configuration Document (BCD) for the ILC, it does not contain any reference to an Asian sample site to consider for modeling a realistic cost studies. The KEK DG should quickly introduce a suitable description of the Asian sample site in the BCD. The Asian region should not fall behind other regions in the area of detailed cost studies with a realistic sample site.

4. KEK DG should lead the studies on a suitable international organizational structure for first promoting, then later executing, the ILC Project, with particular attention to its timely realization and later to hosting of the project in Japan. The KEK DG should lead the efforts to examine the role of KEK in that regard, including its possible reorganization in the future. The importance of aiming at the promotion of all scientific research in Japan must be noted.

- J-PARC/T2K is Japan's flagship project for the next 10 years.

- Realization of ILC is vital to HEP in Japan.


Offline+Online Luminosity (pb-1) (/day)
2006/05/31 07.24
on resonance,
off resonance,
energy scan
Offline+Online Luminosity (pb-1) (/day)
1400
1200
1000
800
600
400
200
0
all data,
on resonance,
off resonance,
energy scan
x 10 2
Integrated Luminosity (pb-1)
6000
5000
4000
3000
2000
1000
0
5/2/1999
3/11/2001
1/19/2003
11/28/2004
10/8/2006
Belle log total : 600124 pb-1
Date
runinfo ver.1.56 Exp3 Run1 - Exp51 Run1578 BELLE LEVEL latest: day is not 24 hours

End